PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-064089
(43)Date of publication of application : 10.03.1995

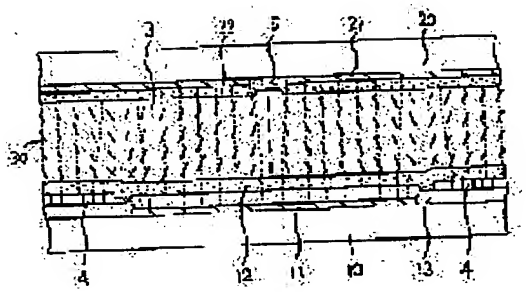
(51)Int.Cl. G02F 1/1337
G02F 1/133
G02F 1/1343
G09G 3/36

(21)Application number : 05-216441
(22)Date of filing : 31.08.1993

(71)Applicant : SANYO ELECTRIC CO LTD
(72)Inventor : KOMA TOKUO

(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PURPOSE: To control the orientation of liquid crystals, to suppress disclination and to improve visual sensation characteristics by setting the potential of orientation control electrodes integrally formed between all pixels higher than the potential of all the other transparent electrodes on a substrate or lower than this potential and providing the display parts of the transparent electrodes with orientation control windows which are electrode-absent parts of a prescribed shape.
CONSTITUTION: The surface of an insulating film 13 is provided with the orientation control electrodes 4 enclosing a predetermined region to serve as the display part. The orientation control electrodes 4 are designed to regulate the inclination direction of the liquid crystals to the inner side of pixels and the potential thereof is set at the effective value higher or lower than the potential of scanning electrodes 11. The liquid crystal molecules 30 of the parts of the orientation control windows 5 formed by the absence of the electrodes in data electrodes 21 in the display region are fixed to an initial perpendicularly oriented state in the liquid crystal layer 3 corresponding to these windows. The inclination direction of the liquid crystal molecules 30 at the peripheral edges of the pixels is regulated by the orientation control electrodes 4 in such a manner and the liquid crystal molecules 30 of the parts corresponding thereto are fixed in the direction perpendicular to the substrate by the orientation control windows 5.



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[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

[Claim(s)]
[Claim 1] The substrate with which the transparent electrode for a scan signal input was prepared, and the substrate with which the transparent electrode for a data signal input was prepared It is the liquid crystal display which it sticks and comes to unite on both sides of a liquid crystal layer. On one substrate of said two substrates The liquid crystal display which the orientation control electrode surrounding the field which said both transparent electrodes superimpose is prepared, and an electrical potential difference which is different from other transparent electrodes on the substrate with which this orientation control electrode was prepared in this orientation control electrode is impressed, and is characterized by things.
[Claim 2] The liquid crystal display according to claim 1 characterized by being higher than all other transparent electrodes on the substrate with which it was prepared to said orientation control electrode, or impressing a low electrical potential difference to it.
[Claim 3] The liquid crystal display according to claim 1 or 2 characterized by preparing the orientation control aperture by which the predetermined part was removed and formed in one [at least] transparent electrode of the field which said both transparent electrodes superimpose.

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the liquid crystal display which attained a good viewing-angle property and high display grace by controlling the orientation of a liquid crystal molecule about a matrix mold liquid crystal display.
[0002]
[Description of the Prior Art] A liquid crystal display has advantages, such as small, a thin shape, and a low power, and to several m pixel xn, especially the matrix mold that carries out time-sharing actuation of each pixel by which matrix arrangement was carried out at a multiplexer type has few terminals as m+n, and fits the big screen. Therefore, it is used for the display of OA equipment, an AV equipment, etc.
[0003] Below, the conventional example is explained, referring to drawing 7 and drawing 8 . It is the sectional view where drawing 7 meets a top view and drawing 8 meets the C-C line of drawing 7 . On a transparence substrate (10), scan electrodes (11), such as ITO, are arranged at plurality, and are arranged at parallel at each other, this is covered and the vertical orientation film (12) is formed in the whole surface. Moreover, on one transparence substrate (20), data electrodes (21), such as ITO, are arranged similarly at parallel at plurality and each other, this is covered in it, and the vertical orientation film (22) is formed in the whole surface. The liquid crystal layer (3) which these two substrates (10 20) become from the liquid crystal which is stuck as a scan electrode (11) and a data electrode (21) intersect perpendicularly mutually, and has a negative dielectric constant anisotropy in a clearance is prepared. A predetermined electrical potential difference is impressed to each scan electrode (11) and a data electrode (21), the effective voltage beyond a threshold is impressed to the pixel chosen as a point display among the pixels driven as an intersection of two electrodes (11 21), the permeability of light is controlled, and the desired display screen is obtained as a set of a point display of these plurality. Especially when the initial orientation of liquid crystal is perpendicularly set up to a substrate, the permeability of light is controlled by the pixel chosen by making a liquid crystal molecule incline in the direction of a field of a substrate. Moreover, by arranging two polarizing plates so that the outside of both substrates (10 20) and polarization shaft orientations may cross at right angles mutually, at the point choosing [un-], light is thoroughly intercepted with a rectangular polarizer, and it becomes black, and with a choosing point, light turns into elliptically polarized light in response to a birefringence in a liquid crystal layer (3), a pixel is penetrated, and it becomes white. Furthermore, although the graphic display was omitted, by establishing between pixels for a wrap light-shielding film in either of two substrates, it can always set between pixels as black, and can raise image quality.
[0004]
[Problem(s) to be Solved by the Invention] However, effect was done in the dip direction of liquid crystal, the orientation vector became an ununiformity, on the borderline of the field where orientation vectors differ mutually, the black part arose in the pixel white on display, and the longitudinal direction electric field between the level difference on the front face of a substrate or an electrode (11 21) had become the

above-mentioned liquid crystal display with disclination. When the disclination of a different configuration for every pixel arose, the whites under selection differed for every pixel, and image quality was deteriorating.

[0005]

[Means for Solving the Problem] The substrate with which this invention was accomplished in view of the above-mentioned technical problem, and the transparent electrode for a scan signal input was prepared in the 1st, The substrate with which the transparent electrode for a data signal input was prepared is the liquid crystal display which it sticks and comes to unite on both sides of a liquid crystal layer. Other transparent electrodes on the substrate with which the orientation control electrode surrounding the field which said both transparent electrodes superimpose was prepared on one substrate of said two substrates, and this orientation control electrode was prepared in this orientation control electrode are the configurations that a different electrical potential difference is impressed.

[0006] To the 2nd, it is higher than all other transparent electrodes on the substrate with which it was prepared in said orientation control electrode in the 1st configuration, or is the configuration that a low electrical potential difference is impressed. It is the configuration that the orientation control aperture which the predetermined part was removed by one [at least] transparent electrode of the field which said both transparent electrodes superimpose in the 1st or 2nd configuration, and was formed in the 3rd was prepared.

[0007]

[Function] Line of electric force generates the potential of the orientation control electrode really formed between [all] pixels between all pixels and an orientation control electrode according to the potential difference of a transparent electrode and an orientation control electrode by setting up low more highly than all other transparent electrodes on the substrate with which it was prepared in the orientation control electrode. In the liquid crystal layer corresponding to the periphery section of a pixel, line of electric force is extended in the direction of slant out of a viewing area from the inside of a viewing area toward the transparent electrode of the opposite from a transparent electrode. although the liquid crystal molecule with a negative dielectric constant anisotropy inclines according to slanting line of electric force -- the continuum of liquid crystal -- it is inclining toward the inside of a pixel and becomes stability in energy so that a molecule major axis may approach a right angle by the shortest to line of electric force at a sex for ****** elasticity. That is, the dip direction of the liquid crystal molecule of the periphery section becomes the inside which is a pixel about all pixels for the electric field by the orientation control electrode.

[0008] Furthermore, since line of electric force does not exist in this part by preparing the orientation control aperture which is the electrode absent part of a predetermined configuration in one [at least] display of the transparent electrode which counters mutually, in the field corresponding to an orientation control aperture, a liquid crystal molecule maintains initial orientation and is fixed to a condition vertical to a substrate. the liquid crystal to which the dip direction was specified inside the pixel with the orientation control electrode in four sides of a pixel -- the continuum -- the field of liquid crystal with the dip direction same for a sex -- a pixel center section -- and since the borderline of four fields which have a mutually different orientation vector arises in a pixel, a borderline is thoroughly in agreement with an orientation control aperture by making an orientation control aperture into X character corresponding to the diagonal line of a pixel especially

[0009]

[Example] Below, one example of this invention is explained, referring to drawing 4 from drawing 1 . One substrate (1) of drawing 1 is a top view a part, and drawing 2 is a sectional view which meets the A-A line of drawing 1 . The transparence electrical conducting material (11), for example, the scan electrode which consists of ITO, is arranged by parallel on the transparence substrate (10) at plurality and each other, this is covered and the laminating of the insulator layers (13), such as SiNX, is carried out to the whole surface. On the insulator layer (13), the orientation control electrode (4) surrounding the field which is due to serve as a display is prepared. An orientation control electrode (4) carries out the laminating of the electrical conducting materials, such as Cr, aluminum, Ti, and ITO, to the thickness of about 1000A, and is formed by removing a display by etching. Furthermore, the vertical orientation film (12) is prepared in the whole surface, and a substrate (1) is constituted.

[0010] Moreover, the substrate (2) of drawing 3 of another side is a top view a part, and drawing 4 is a sectional view which meets the B-B line of drawing 3 . The orientation control aperture (5) of the X shape with which the transparence electrical conducting material (21), for example, the data electrode which consists of ITO, was formed in plurality and the field which is arranged mutually at parallel and is due to serve as a display in an electrode of the absence of an electrode is prepared on the transparence

substrate (20). In the case of patterning of ITO, etching clearance of the predetermined part is carried out, and an orientation control aperture (5) is formed in formation and coincidence of a data electrode (21). Furthermore, the vertical orientation film (22) is prepared in the whole surface, and a substrate (2) is constituted.

[0011] The liquid crystal with which both the substrates (1) of the above structure and (2) are stuck so that a scan electrode (11) and a data electrode (21) may intersect perpendicularly mutually, and they have a negative dielectric constant anisotropy in a clearance is enclosed, and the liquid crystal display which is the example of this invention is constituted. Drawing 5 is a sectional view for 1 pixel, and drawing 6 is the top view having shown the physical relationship of the scan electrode (11) when sticking both substrates (1) and (2), a data electrode (21), and an orientation control aperture (5). An orientation control electrode (4) is for specifying the dip direction of liquid crystal inside a pixel, and potential is higher than all scan electrodes (11), or is set as low actual value. From this, the line of electric force of the configuration shown by the dotted line of drawing 5 arises between two electrodes (11 21) and an orientation control electrode (4). That is, in the edge of a pixel, the line of electric force which goes in the slanting upper part from a scan electrode (11) out of a viewing area arises from the inside of a viewing area for the electric field between a scan electrode (11) and an orientation control electrode (4). Although the liquid crystal molecule (30) with a negative dielectric constant anisotropy inclines in the direction in which a molecule major axis becomes a right angle to line of electric force according to this, for ****** elasticity, it is inclining inside a pixel so that a right angle may be approached by the shortest, and serves as stability in energy the continuation somatic of liquid crystal. Moreover, in the liquid crystal layer (3) corresponding to the orientation control aperture (5) formed of the absence of an electrode into the data electrode in a viewing area (21), line of electric force does not exist, or since it is [that the electrical potential difference below a threshold is only impressed at least, and], the liquid crystal molecule (30) of this part is fixed to an early vertical orientation condition. Thus, by the periphery section of a pixel prescribing the dip direction of a liquid crystal molecule (30) with an orientation control electrode (4), and fixing the liquid crystal molecule (30) of the part corresponding to this perpendicularly to a substrate by the orientation control aperture (5) the continuum of liquid crystal -- as shown by the arrow head of drawing 6 for a sexual operation, in four fields divided by the orientation control aperture (5) of an X shape, the dip direction of liquid crystal is right-angled each side of a pixel, and becomes in the direction of the inside, and the borderline of each field where the dip directions differ mutually is fixed on an orientation control aperture (5).

[0012] Having explained above is same, even if it is not limited to the example shown by this application, for example, prepares an orientation control electrode (4) in a data electrode (21) side and prepares an orientation control aperture (5) in a scan electrode (11) side.

[0013]

[Effect of the Invention] As mentioned above, by controlling the orientation of liquid crystal, by controlling the disclination of a different configuration for every pixel, and fixing by the same orientation control aperture about all pixels, the chromaticity and brightness of all choosing points became homogeneity, and display grace improved. Especially when an orientation control aperture was taken to an X shape, in fields other than an orientation control aperture, disclination disappeared thoroughly. Moreover, since the area of the field where the orientation vectors of the liquid crystal molecule per pixel differ became equivalent covering four directions, the viewing-angle dependency of a contrast ratio decreased and the viewing-angle property improved.

[Brief Description of the Drawings]

[Drawing 1] While constitutes the liquid crystal display which is the example of this invention, and it is the top view of a substrate.

[Drawing 2] It is the sectional view which meets the A-A line of drawing 1.

[Drawing 3] It is the top view of the substrate of another side which constitutes the liquid crystal display which is the example of this invention.

[Drawing 4] It is the sectional view which meets the B-B line of drawing 3.

[Drawing 5] It is drawing explaining the operation effectiveness of this invention.

[Drawing 6] It is drawing explaining the operation effectiveness of this invention.

[Drawing 7] It is the top view of the conventional liquid crystal display.

[Drawing 8] It is the sectional view which meets the C-C line of drawing 7.

[Description of Notations]

1 Two Substrate
2 TFT Substrate
3 Liquid Crystal Layer
4 Orientation Control Electrode
5 Orientation Control Aperture
10 Transparence Substrate

11 Scan ****
12 22 Vertical orientation film
13 Insulator Layer
21 Data Electrode
30 Liquid Crystal Molecule

(19)日本国特許庁（JP）　(12) 公開特許公報（A）　(11)特許出願公開番号
特開平7－64089
(43)公開日　平成7年(1995)3月10日

(51)Int.Cl.⁶		識別記号	庁内整理番号	F I	技術表示箇所
G02F	1/1337				
	1/133	505			
	1/1343				
G09G	3/36				

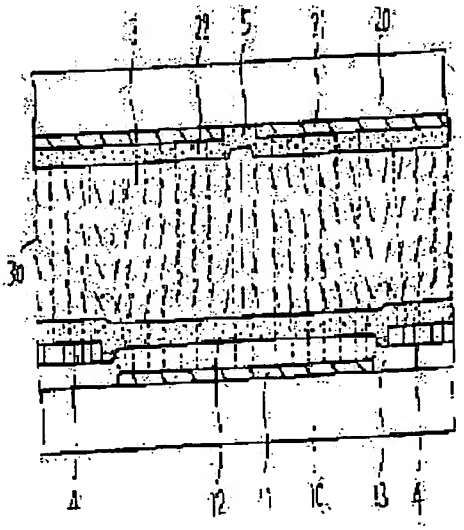
審査請求　未請求　請求項の数3　OL　（全 5 頁）

(21)出願番号　特願平5－216441
(22)出願日　平成5年(1993)8月31日

(71)出願人　000001889
三洋電機株式会社
大阪府守口市京阪本通2丁目5番5号
(72)発明者　小岡　佳夫
大阪府守口市京阪本通2丁目18番地　三洋電機株式会社内
(74)代理人　弁理士　西野　卓嗣

(54)【発明の名称】　液晶表示装置

(57)【要約】
【目的】　垂直配向マトリクス液晶表示装置において、液晶分子の配向方向を制御することにより、ディスクリネーションの出現による、表示品位の低下を防止するとともに、視角特性を向上する。
【構成】　画素面に配向制御電極（4）を設け、これに他の全ての透明電極よりも高いか、または、低い実効電圧を印加し、かつ、透明電極に電極不在により形成された配向制御窓（5）を設けることにより、液晶層（3）中の電界を調整して、液晶分子の配向を制御する。



【特許請求の範囲】

【請求項１】　走査信号入力用の透明電極が設けられた基板と、データ信号入力用の透明電極が設けられた基板が、液晶層を挟んで貼り合わされてなる液晶表示装置であって、

前記２枚の基板の一方の基板上に、前記両透明電極が重畳する領域を囲む配向制御電極が設けられ、かつ、該配向制御電極には、該配向制御電極が設けられた基板上の他の透明電極とは異なる電圧が印加されることを特徴とする液晶表示装置。

【請求項２】　前記配向制御電極には、それが設けられた基板上の他の全ての透明電極よりも高いか、または、低い電圧が印加されることを特徴とする請求項１記載の液晶表示装置。

【請求項３】　前記両透明電極が重畳する領域の、少なくとも一方の透明電極には、所定の部分が取り除かれて形成された配向制御窓が設けられることを特徴とする請求項１または請求項２記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、マトリクス型液晶表示装置に関し、特に、液晶分子の配向を制御することにより、良好な視角特性と高表示品位を達成した液晶表示装置に関する。

【０００２】

【従来の技術】液晶表示装置は小型、薄型、低消費電力などの利点があり、特に、マトリクス配置された各画素を、マルチプレクス式に時分割駆動するマトリクス型は、画素数ｍ×ｎに対して、端子数がｍ＋ｎと少なく、大画面に適している。そのため、ＯＡ機器、ＡＶ機器などのディスプレイに用いられている。

【０００３】以下で、従来例を図７及び図８を参照しながら説明する。図７は平面図、図８は図７のＣ－Ｃ線に沿う断面図である。透明基板（１０）上に、ＩＴＯなどの走査電極（１１）が複数、互いに平行に配置されており、これを覆って全面には、垂直配向膜（１２）が形成されている。また、一方の透明基板（２０）上には、ＩＴＯなどのデータ電極（２１）が同様に複数、互いに平行に配置され、これを覆って全面には、垂直配向膜（２２）が形成されている。これら２枚の基板（１０，２０）が、走査電極（１１）とデータ電極（２１）が互いに直交するようにして貼り合わされ、隙間に負の誘電率異方性を持つ液晶よりなる液晶層（３）が設けられる。各走査電極（１１）及びデータ電極（２１）に所定の電圧が印加され、両電極（１１，２１）の交点として駆動される画素のうち、点表示として選択される画素には、閾値以上の実効電圧が印加されて光の透過率が制御され、これら複数の点表示の集合として、所望の表示画面が得られる。特に、液晶の初期配向を基板に対して垂直方向に設定した場合は、選択される画素では、液晶分子を基板の面方向に傾斜させることにより、光の透過率が制御される。また、両基板（１０，２０）の外側に、偏光軸方向が互いに直交するように２枚の偏光板を配置することにより、非選択点では光が直交偏光子で完全に遮断されて黒になり、選択点では光が液晶層（３）で楕円偏光となり、画素を透過して白となる。更に、図示は省略したが、画素間を覆う遮光膜を２枚の基板のいずれかに設けることにより、画素間を常時黒に設定して、画質を向上させることができる。

【０００４】

【発明が解決しようとする課題】しかし、前述の液晶表示装置には、基板表面の段差や電極（１１，２１）間の横方向電界が、液晶の傾斜方向に悪影響を及ぼして配向ベクトルが不均一になり、配向ベクトルが互いに異なる領域の境界線上では、白表示中の画素に黒の部分が生じて、ディスクリネーションとなっていた。各画素ごとに異なる形状のディスクリネーションが生じると、選択中の白色が画素ごとに異なり、画質が悪化していた。

【０００５】

【課題を解決するための手段】本発明は前述の課題に鑑みて成され、第１に、走査信号入力用の透明電極が設けられた基板と、データ信号入力用の透明電極が設けられた基板が、液晶層を挟んで貼り合わされてなる液晶表示装置であって、前記２枚の基板の一方の基板上に、前記両透明電極が重畳する領域を囲む配向制御電極が設けられ、かつ、該配向制御電極には、該配向制御電極が設けられた基板上の他の透明電極とは異なる電圧が印加される構成である。

【０００６】第２に、第１の構成において、前記配向制御電極には、それが設けられた基板上の他の全ての透明電極よりも高いか、または、低い電圧が印加される構成である。第３に、第１又は第２の構成において、前記両透明電極が重畳する領域の、少なくとも一方の透明電極には、所定の部分が取り除かれて形成された配向制御窓が設けられた構成である。

【０００７】

【作用】全画素間に一体形成される配向制御電極の電位を、その配向制御電極が設けられた基板上の他の全ての透明電極よりも高く、または、低く設定することにより、透明電極と配向制御電極との電位差により、全画素と配向制御電極との間に電気力線が発生する。画素の周縁部に対応する液晶層中では、電気力線が透明電極から対向の透明電極に向かって、表示領域内から表示領域外へ斜め方向に伸びる。負の誘電率異方性を持つ液晶分子は、斜めの電気力線に従って傾斜するが、液晶の連続体性に基ずく弾性のために、分子長軸が電気力線に対して最短で直角に近付くように、画素の内側に向かって傾斜することで、エネルギー的に安定となる。即ち、配向制御電極による電界のために、全画素について、周縁部の液晶分子の傾斜方向が画素の内側になる。

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【０００８】更に、互いに対向する透明電極の少なくとも一方の表示部に、所定の形状の電極不在部分である配向制御窓を設けることにより、この部分では電気力線が存在しないので、配向制御窓に対応する領域では液晶分子は初期配向を保って、基板に垂直な状態に固定される。画素の４辺において配向制御電極により傾斜方向を画素の内側に規定された液晶は、その連続体性のために同じ傾斜方向を持つ液晶の領域が画素中央部にも及び、互いに異なる配向ベクトルを有する４つの領域の境界線が画素内に生ずるので、特に、配向制御窓を画素の対角線に対応する×字にすることにより、境界線が配向制御窓に完全に一致する。

【０００９】

【実施例】以下で、本発明の一実施例を図１から図４を参照しながら説明する。図１は一方の基板（１）の一部平面図であり、図２は図１のＡ－Ａ線に沿う断面図である。透明基板（１０）上に透明導電材料、例えばＩＴＯよりなる走査電極（１１）が複数、互いに平行に配置されており、これを覆って全面には、ＳｉＮＸなどの絶縁膜（１３）が積層されている。絶縁膜（１３）上には、表示部となる予定の領域を囲む配向制御電極（４）が設けられている。配向制御電極（４）は、Ｃｒ、Ａｌ、Ｔｉ、ＩＴＯなどの導電材料を１０００Ａ程度の厚さに積層して、エッチングにより表示部を除去することにより形成される。更に、全面には垂直配向膜（１２）が設けられて基板（１）が構成される。

【００１０】また、図３は他方の基板（２）の一部平面図であり、図４は図３のＢ－Ｂ線に沿う断面図である。透明基板（２０）上に透明導電材料、例えばＩＴＯよりなるデータ電極（２１）が複数、互いに平行に配置されており、電極中の表示部となる予定の領域には、電極の不在により形成された×字型の配向制御窓（５）が設けられている。配向制御窓（５）はＩＴＯのパターニングの際、データ電極（２１）の形成と同時に所定の部分がエッチング除去されて形成される。更に、全面には、垂直配向膜（２２）が設けられて基板（２）が構成される。

【００１１】以上の構造の両基板（１）、（２）が、走査電極（１１）とデータ電極（２１）が互いに直交するように貼り合わされ、隙間に負の誘電率異方性をもつ液晶が封入されて本発明の実施例である液晶表示装置が構成される。図５は１画素分の断面図であり、図６は両基板（１）（２）を貼り合わせたときの走査電極（１１）、データ電極（２１）及び配向制御窓（５）の位置関係を示した平面図である。配向制御電極（４）は液晶の傾斜方向を画素の内側に規定するためのものであり、電位は全ての走査電極（１１）よりも高いか、または、低い実効値に設定される。これより、両電極（１１；２１）と配向制御電極（４）の間には、図５の点線で示される形状の電気力線が生じる。即ち、走査電極（１１）と配向制御電極（４）間の電界のため、画素の端部において、表示領域内から表示領域外へ、走査電極（１１）から斜め上方に向かう電気力線が生じる。負の誘電率異方性をもつ液晶分子（３０）は、これにしたがって分子長軸が電気力線に直角になる方向に傾斜するが、液晶の連続体性に基ずく弾性のために、最短で直角に近付くように画素の内側に傾斜することで、エネルギー的に安定となる。また、表示領域内のデータ電極（２１）中に電極の不在により形成された配向制御窓（５）に対応する液晶層（３）中では、電気力線が存在しないか、少なくとも閾値以下の電圧が印加されるのみであるため、この部分の液晶分子（３０）は初期の垂直配向状態に固定される。このように、配向制御電極（４）により画素の周辺部で液晶分子（３０）の傾斜方向を規定し、配向制御窓（５）でこれに対応する部分の液晶分子（３０）を基板に対して垂直方向に固定することにより、液晶の連続体性の作用のために、図６の矢印で示されるように、×字型の配向制御窓（５）で区切られた４つの領域では、液晶の傾斜方向は画素の各辺に直角で内側方向になり、互いに傾斜方向の異なる各領域の境界線は、配向制御窓（５）上に固定される。

【００１２】以上に説明してきたことは、本願で示した実施例に限定されず、例えば、配向制御電極（４）をデータ電極（２１）側に、配向制御窓（５）を走査電極（１１）側に設けても同様である。

【００１３】

【発明の効果】以上のように、液晶の配向を制御することにより、画素ごとに異なる形状のディスクリネーションを抑制し、全画素について同一の配向制御窓で固定することにより、全選択点の色調や輝度が均一になり、表示品位が向上した。特に、配向制御窓を×字型にとった場合は、配向制御窓以外の領域ではディスクリネーションは完全に消滅した。また、１画素につき、液晶分子の配向ベクトルが異なる領域の面積が、４方向にわたって同等になるので、コントラスト比の視角依存性が低減し、視角特性が向上した。

【図面の簡単な説明】

【図１】本発明の実施例である液晶表示装置を構成する一方の基板の平面図である。

【図２】図１のＡ－Ａ線に沿う断面図である。

【図３】本発明の実施例である液晶表示装置を構成する他方の基板の平面図である。

【図４】図３のＢ－Ｂ線に沿う断面図である。

【図５】本発明の作用効果を説明する図である。

【図６】本発明の作用効果を説明する図である。

【図７】従来の液晶表示装置の平面図である。

【図８】図７のＣ－Ｃ線に沿う断面図である。

【符号の説明】

１，２　基板

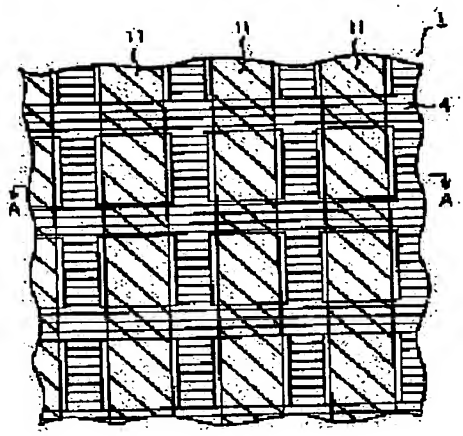
２　ＴＦＴ基板

5-3

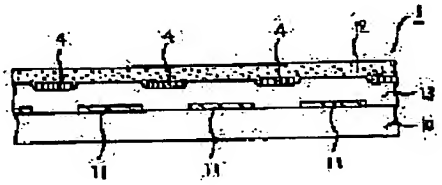
3　液晶層
4　配向制御電極
5　配向制御表
10　透明基板
11　走査信電極

12，22　垂直配向膜
13　絶縁膜
21　データ電極
30　液晶分子

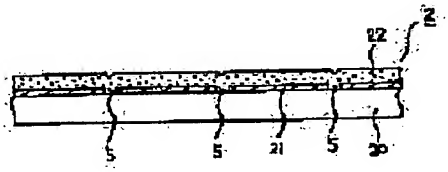
〔図1〕



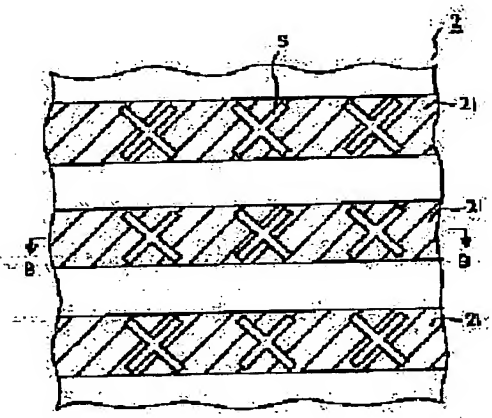
〔図2〕



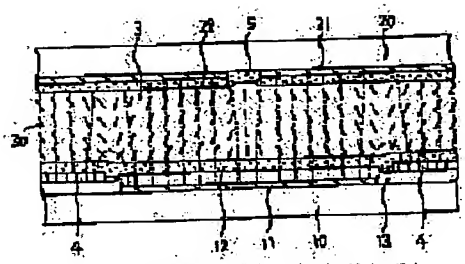
〔図4〕



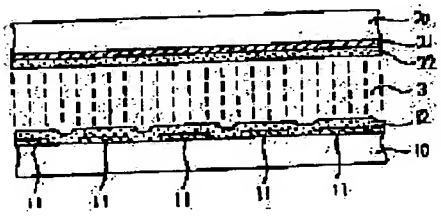
〔図3〕



〔図5〕



〔図8〕



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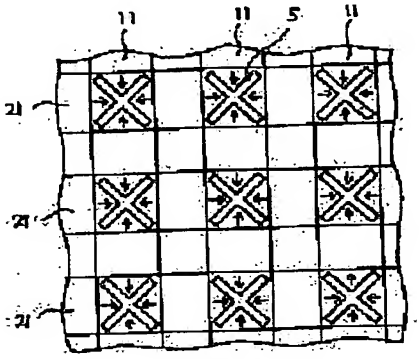
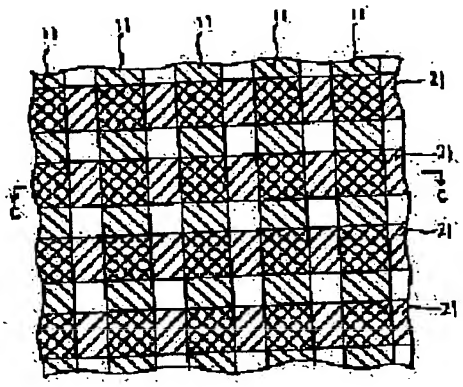
【図6】



【図7】



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